

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

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Listing of Claims:

1. (Previously presented) A gas-permeable membrane which is useful in the packaging of respiring biological materials and which comprises

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- (a) a microporous polymeric film comprising a network of interconnected pores such that gases can pass through the film, and
- (b) a polymeric coating on the microporous film,

wherein

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- (1) the pores in the microporous film have an average pore size of less than 0.24 micron; and

- (2) the microporous film was prepared by a process comprising the steps of

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(A) preparing a uniform mixture comprising a polymeric matrix material in the form of a powder, a finely divided, particulate, substantially water-insoluble filler, and a processing oil;

(B) extruding the mixture as a continuous sheet;

(C) forwarding the continuous sheet, without drawing, to a pair of heated calender rolls;

(D) passing the continuous sheet through the calender rolls to form a sheet of lesser thickness;

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(E) passing the sheet from step (D) to a first extraction zone in which the processing oil is substantially removed by extraction with an organic extraction liquid which is a good solvent for the processing oil, a poor solvent for the polymeric matrix material, and more volatile than the processing oil;

(F) passing the sheet from step (E) to a second extraction zone in which the organic extraction liquid is substantially removed by steam or water or both; and

(G) passing the sheet from step (F) through a forced air dryer to remove residual water and organic extraction liquid; and

(3) the polymeric coating has a thickness such that the membrane

(i) has a P_{10} ratio, over at least one 10 °C range between -5 and 15°C, of at least 1.3;

(ii) has an oxygen permeability (OTR), at all temperatures between 20 and 25 °C, of at least 775,000 ml/m².atm.24 hrs (50,000 cc/100 inch².atm.24 hrs; and

(iii) has a CO₂/O₂ permeability ratio(R) of at least 1.5;

the P_{10} , OTR and R values being measured at a pressure of 0.035 kg/cm² (0.5 psi).

2. (Previously presented) A membrane according to claim 1 wherein the polymeric matrix material is selected from the group consisting of

(i) an essentially linear ultrahigh molecular weight polyethylene having an intrinsic viscosity of at least 18 deciliters/g, and

(ii) an essentially linear ultrahigh molecular weight polypropylene having an intrinsic viscosity of at least 6 deciliters/g.

3. (Currently amended) A membrane according to claim 1 wherein

(1) at least 70% of the pores in the microporous film have a pore size of less than 0.24 micron;

(2) less than 20% of the pores in the microporous film have a pore size less than 0.014 micron; and

(3) at least 80% of the pores in the microporous film have a pore size less than 0.15 micron.

4-6. Canceled

7. (Previously presented) A membrane according to Claim 1 which has an OTR of at least 1,550,000 ml/m².atm.24 hrs (100,000 cc/inch².atm.24 hrs), and an R ratio of at least 2, the OTR and R values being measured at a pressure of 0.7 kg/cm² (10 psi).

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8. (Previously presented) A membrane according to claim 7 which has an OTR of at least 2,325,000 ml/m².atm.24 hrs (150,000 cc/100 inch².atm.24 hrs) measured at a pressure of 0.7 kg/cm² (10 psi).

10 9-12. Canceled

13. (Previously presented) A membrane according to claim 1 wherein the coating polymer has been crosslinked.

15 14. Canceled

15. (Previously presented) A membrane according to claim 1 wherein the microporous polymeric film contains pores which are partially blocked by a polymer having an R ratio of less than 1.3 or by a particulate material.

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16. (Previously presented) A package which is stored in air and which comprises
(a) a sealed container, and
(b) within the sealed container, a respiring biological material and a packaging atmosphere around the biological material;

25 the sealed container including one or more permeable control sections which provide at least the principal pathway for oxygen and carbon dioxide to enter or leave the packaging atmosphere, at least one said permeable control section being a gas-permeable membrane as defined in claim 1.

30 17-19. Canceled

20. (Previously presented) A gas-permeable membrane which is useful in the packaging of respiring biological materials and which comprises

(a) a microporous polymeric film comprising a network of interconnected pores such that gases can pass through the film, and

(b) a polymeric coating on the microporous film,

wherein

(1) the pores in the microporous film have an average pore size of less than 0.24 micron;

(2) at least 70% of the pores in the microporous film have a pore size of less than 0.24 micron;

(3) less than 20% of the pores in the microporous film have a pore size less than 0.014 micron;

(4) at least 80% of the pores in the microporous film have a pore size less than 0.15 micron; and

(5) the polymeric coating has a thickness such that the membrane

(i) has a P_{10} ratio, over at least one 10°C range between -5 and 15 °C, of at least 1.3;

(ii) has an oxygen permeability (OTR), at all temperatures between 20° and 25°C, of at least 775,000 ml/m².atm.24 hrs (50,000 cc/100 inch².atm.24 hrs; and

(iii) has a CO₂/O₂ permeability ratio(R) of at least 1.5;

the P_{10} , OTR and R values being measured at a pressure of 0.035 kg/cm² (0.5 psi).

21. Canceled.

22. Canceled

23. (Previously presented) A membrane according to claim 20 wherein at least 80% of the pores in the microporous film have a pore size less than 0.15 micron and at least 70% of the pores in the microporous film have a pore size less than 0.11 micron.

24. (Previously presented) A membrane according to claim 20 which has an OTR at all temperatures between 20°C and 25°C of at least 1,550,000 ml/m².atm.24 hrs (100,000 cc/inch².atm.24 hrs) and an R ratio of at least 2.5, the OTR and R values
5 being measured at a pressure of 0.035 kg/cm² (0.5 psi).

25. (Currently amended) A membrane according to claim 20 which has an OTR of at least 2,325,000 ml/m².atm.24 hrs (150,000 cc/100 inch².atm.24 hrs) measured at a pressure of 0.7-0.07 kg/cm² (10 psi).

10 26-27. Canceled

28. (Previously presented) A membrane according to claim 20 wherein the coating polymer has been crosslinked.

15 29. (Previously presented) A package which is stored in air and which comprises
(a) a sealed container, and
(b) within the sealed container, a respiring biological material and a packaging atmosphere around the biological material;

20 the sealed container including one or more permeable control sections which provide at least the principal pathway for oxygen and carbon dioxide to enter or leave the packaging atmosphere, at least one said permeable control section being a gas-permeable membrane which comprises

(a) a microporous polymeric film comprising a network of interconnected
25 pores such that gases can pass through the film, and

(b) a polymeric coating on the microporous film,

wherein

(1) the pores in the microporous film have an average pore size of less than 0.24 micron;

30 (2) at least 70% of the pores in the microporous film have a pore size of less than 0.24 micron;

(3) less than 20% of the pores in the microporous film have a pore size less than 0.014 micron;

(4) at least 80% of the pores in the microporous film have a pore size less than 0.15 micron; and

- 5 (5) the polymeric coating has a thickness such that the membrane
- (i) has a P_{10} ratio, over at least one 10°C range between -5 and 15 °C, of at least 1.3;
- (ii) has an oxygen permeability (OTR), at all temperatures between 20° and 25°C, of at least 775,000 ml/m².atm.24 hrs (50,000 cc/100
- 10 inch².atm.24 hrs; and
- (iii) has a CO₂/O₂ permeability ratio(R) of at least 1.5;
- the P_{10} , OTR and R values being measured at a pressure of 0.035 kg/cm² (0.5 psi).

15 30. (Previously presented) A membrane according to claim 1 wherein the filler is a siliceous filler.

31. (Previously presented) A membrane according to claim 20 wherein the microporous polymeric film comprises a polymeric matrix having a siliceous filler

20 dispersed therein.

32. (Previously presented) A membrane according to claim 31 wherein the polymeric matrix is composed of polyethylene and the distribution of pore sizes in the microporous film is as set out in the following table

Pore Size (microns)	.013	.016	.026	.044	.058	.08	.11	.15	.24	.36	.6
% of pores larger than pore size	90%	80%	70%	60%	50%	40%	30%	20%	10%	5%	2%

33. (Previously presented) A membrane according to claim 30 wherein the polymeric matrix is composed of polyethylene and the distribution of pore sizes in the microporous film is as set out in the following table

Pore Size (microns)	.013	.016	.026	.044	.058	.08	.11	.15	.24	.36	.6
% of pores larger than pore size	90%	80%	70%	60%	50%	40%	30%	20%	10%	5%	2%

34. (New) A membrane according to claim 1 wherein the coating polymer has at least one of the following characteristics:

- (1) it comprises an acrylate polymer containing at least 40% by weight of units derived from a cycloalkyl acrylate or methacrylate;
- (2) it comprises a fluoropolymer;
- (3) it comprises an acrylate polymer containing units derived from a fluoroalkyl acrylate or methacrylate; and
- (4) it comprises an acrylate polymer containing 10 to 70% of units derived from a polyethylene glycol acrylate or methacrylate.

35. (New) A membrane according to claim 20 wherein the coating polymer has at least one of the following characteristics:

- (1) it comprises an acrylate polymer containing at least 40% by weight of units derived from a cycloalkyl acrylate or methacrylate;
- (2) it comprises a fluoropolymer;
- (3) it comprises an acrylate polymer containing units derived from a fluoroalkyl acrylate or methacrylate; and
- (4) it comprises an acrylate polymer containing 10 to 70% of units derived from a polyethylene glycol acrylate or methacrylate.

36. (New) A gas-permeable membrane which is useful in the packaging of respiring biological materials and which comprises

- (a) a microporous polymeric film comprising a network of interconnected pores such that gases can pass through the film, and
- (b) a polymeric coating on the microporous film,

wherein

(1) the pores in the microporous film have an average pore size of less than 0.24 micron; and

(2) the microporous film was prepared by a process comprising the steps of

(A) preparing a uniform mixture comprising a polymeric matrix material in the form of a powder, a finely divided, particulate, substantially water-insoluble filler, and a processing oil;

(B) extruding the mixture as a continuous sheet;

(C) forwarding the continuous sheet, without drawing, to a pair of heated calender rolls;

(D) passing the continuous sheet through the calender rolls to form a sheet of lesser thickness;

(E) passing the sheet from step (D) to a first extraction zone in which the processing oil is substantially removed by extraction with an organic extraction liquid which is a good solvent for the processing oil, a poor solvent for the polymeric matrix material, and more volatile than the processing oil;

(F) passing the sheet from step (E) to a second extraction zone in which the organic extraction liquid is substantially removed by steam or water or both; and

(G) passing the sheet from step (F) through a forced air dryer to remove residual water and organic extraction liquid; and

(3) the polymeric coating has a thickness such that the membrane

(i) has an oxygen permeability (OTR), at all temperatures between 20

and 25 °C, of at least 775,000 ml/m².atm.24 hrs (50,000 cc/100 inch².atm.24 hrs; and

(ii) has a CO₂/O₂ permeability ratio(R) of at least 1.5; the OTR and R values being measured at a pressure of 0.035 kg/cm² (0.5 psi).

37. (New) A membrane according to claim 36 wherein the polymeric matrix material is selected from the group consisting of

(i) an essentially linear ultrahigh molecular weight polyethylene having an intrinsic viscosity of at least 18 deciliters/g and

(ii) an essentially linear ultrahigh molecular weight polypropylene having an intrinsic viscosity of at least 6 deciliters/g.

38. (New) A membrane according to claim 36 wherein

(1) at least 70% of the pores in the microporous film have a pore size of less than 0.24 micron;

(2) less than 20% of the pores in the microporous film have a pore size less than 0.014 micron; and

(3) at least 80% of the pores in the microporous film have a pore size less than 0.15 micron.

39. (New) A membrane according to Claim 36 which has an OTR of at least 1,550,000 ml/m².atm.24 hrs (100,000 cc/inch².atm.24 hrs), and an R ratio of at least 2, the OTR and R values being measured at a pressure of 0.7 kg/cm² (10 psi).

40. (New) A membrane according to claim 39 which has an OTR of at least 2,325,000 ml/m².atm.24 hrs (150,000 cc/100 inch².atm.24 hrs) measured at a pressure of 0.7 kg/cm² (10 psi).

41. (New) A membrane according to claim 36 wherein the coating polymer comprises a polydimethyl siloxane.

42 (New) A membrane according to claim 36 wherein the coating polymer comprises cis-polybutadiene, poly(4-methylpentene) or ethylene-propylene rubber.

5 43. (New) A membrane according to claim 36 wherein the coating polymer has at least one of the following characteristics:

(1) it comprises an acrylate polymer containing at least 40% by weight of units derived from a cycloalkyl acrylate or methacrylate;

(2) it comprises a fluoropolymer;

10 (3) it comprises an acrylate polymer containing units derived from a fluoroalkyl acrylate or methacrylate; and

(4) it comprises an acrylate polymer containing 10 to 70% of units derived from a polyethylene glycol acrylate or methacrylate.

15 44. (New) A membrane according to claim 36 wherein the coating polymer has been crosslinked.

45. (New) A membrane according to claim 36 wherein the microporous polymeric film contains pores which are partially blocked by a polymer having an R ratio of less
20 than 1.3 or by a particulate material.

46. (New) A membrane according to claim 36 wherein the filler is a siliceous filler.

47. (New) A package which comprises

25 (a) a sealed container, and

(b) within the sealed container, a respiring biological material and a packaging atmosphere around the biological material;

the sealed container including one or more permeable control sections which provide at least the principal pathway for oxygen and carbon dioxide to enter or leave the
30 packaging atmosphere, at least one said permeable control section being a gas-permeable membrane as defined in claim 36.

48. (New) A gas-permeable membrane which is useful in the packaging of respiring biological materials and which comprises

- (a) a microporous polymeric film comprising a network of interconnected pores such that gases can pass through the film, and
- (b) a polymeric coating on the microporous film,

wherein

- (1) the pores in the microporous film have an average pore size of less than 0.24 micron;
- (2) at least 70% of the pores in the microporous film have a pore size of less than 0.24 micron;
- (3) less than 20% of the pores in the microporous film have a pore size less than 0.014 micron;
- (4) at least 80% of the pores in the microporous film have a pore size less than 0.15 micron; and
- (5) the polymeric coating has a thickness such that the membrane
 - (i) has an oxygen permeability (OTR), at all temperatures between 20° and 25°C, of at least 775,000 ml/m².atm.24 hrs (50,000 cc/100 inch².atm.24 hrs; and
 - (ii) has a CO₂/O₂ permeability ratio(R) of at least 1.5;the OTR and R values being measured at a pressure of 0.035 kg/cm² (0.5 psi).

49. (New) A membrane according to claim 48 wherein at least 90% of the pores in the microporous film have a pore size less than 0.24 micron.

50. (New) A membrane according to claim 48 wherein at least 80% of the pores in the microporous film have a pore size less than 0.15 micron and at least 70% of the pores in the microporous film have a pore size less than 0.11 micron.

51. (New) A membrane according to claim 48 which has an OTR at all temperatures between 20°C and 25°C of at least 1,550,000 ml/m².atm.24 hrs (100,000 cc/inch².atm.24 hrs) and an R ratio of at least 2.5, the OTR and R values being measured at a pressure of 0.035 kg/cm² (0.5 psi).

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52. (New) A membrane according to claim 51 which has an OTR of at least 2,325,000 ml/m².atm.24 hrs (150,000 cc/100 inch².atm.24 hrs) measured at a pressure of 0.7 kg/cm² (10 psi).

10 53. (New) A membrane according to claim 48 wherein the coating polymer comprises cis-polybutadiene, poly(4-methylpentene) or ethylene-propylene rubber.

54. (New) A membrane according to claim 48 wherein the coating polymer has at least one of the following characteristics:

- 15 (1) it comprises an acrylate polymer containing at least 40% by weight of units derived from a cycloalkyl acrylate or methacrylate;
- (2) it comprises a fluoropolymer;
- (3) it comprises an acrylate polymer containing units derived from a fluoroalkyl acrylate or methacrylate; and
- 20 (4) it comprises an acrylate polymer containing 10 to 70% of units derived from a polyethylene glycol acrylate or methacrylate.

55. (New) A membrane according to claim 48 wherein the coating polymer has been crosslinked.

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56. (New) A package which comprises

- (a) a sealed container, and
- (b) within the sealed container, a respiring biological material and a packaging atmosphere around the biological material;

30 the sealed container including one or more permeable control sections which provide at least the principal pathway for oxygen and carbon dioxide to enter or leave the

packaging atmosphere, at least one said permeable control section being a gas-permeable membrane which comprises

(a) a microporous polymeric film comprising a network of interconnected pores such that gases can pass through the film, and

5 (b) a polymeric coating on the microporous film,

wherein

(1) the pores in the microporous film have an average pore size of less than 0.24 micron;

10 (2) at least 70% of the pores in the microporous film have a pore size of less than 0.24 micron;

(3) less than 20% of the pores in the microporous film have a pore size less than 0.014 micron;

(4) at least 80% of the pores in the microporous film have a pore size less than 0.15 micron; and

15 (5) the polymeric coating has a thickness such that the membrane

(i) has an oxygen permeability (OTR), at all temperatures between 20° and 25°C, of at least 775,000 ml/m².atm.24 hrs (50,000 cc/100 inch².atm.24 hrs); and

20 (ii) has a CO₂/O₂ permeability ratio(R) of at least 1.5;
the OTR and R values being measured at a pressure of 0.035 kg/cm² (0.5 psi).

57. (New) A package according to claim 56 wherein at least 90% of the pores in the microporous film have a pore size less than 0.24 micron.

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58. (New) A package according to claim 56 wherein at least 80% of the pores in the microporous film have a pore size less than 0.15 micron and at least 70% of the pores in the microporous film have a pore size less than 0.11 micron.

30 59. (New) A package according to claim 56 which has an OTR at all temperatures between 20°C and 25°C of at least 1,550,000 ml/m².atm.24 hrs (100,000

cc/inch².atm.24 hrs) and an R ratio of at least 2.5, the OTR and R values being measured at a pressure of 0.035 kg/cm² (0.5 psi).

5 60. (New) A package according to claim 59 which has an OTR of at least 2,325,000 ml/m².atm.24 hrs (150,000 cc/100 inch².atm.24 hrs) measured at a pressure of 0.7 kg/cm² (10 psi).

10 61. (New) A package according to claim 56 wherein the coating polymer comprises cis-polybutadiene, poly(4-methylpentene) or ethylene-propylene rubber.

62. (New) A package according to claim 56 wherein the coating polymer has at least one of the following characteristics:

- 15 (1) it comprises an acrylate polymer containing at least 40% by weight of units derived from a cycloalkyl acrylate or methacrylate;
- (2) it comprises a fluoropolymer;
- (3) it comprises an acrylate polymer containing units derived from a fluoroalkyl acrylate or methacrylate; and
- (4) it comprises an acrylate polymer containing 10 to 70% of units derived from a polyethylene glycol acrylate or methacrylate.

20 63. (New) A package according to claim 56 wherein the coating polymer has been crosslinked.

25 64. (New) A package according to claim 56 wherein the microporous polymeric film comprises a polymeric matrix having a siliceous filler dispersed therein.

30 65. (New) A package according to claim 64 wherein the polymeric matrix is composed of polyethylene and the distribution of pore sizes in the microporous film is as set out in the following table

Pore Size (microns)	.013	.016	.026	.044	.058	.08	.11	.15	.24	.36	.6
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% of pores larger than pore size	90%	80%	70%	60%	50%	40%	30%	20%	10%	5%	2%
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66. (New) A gas-permeable membrane which is useful in the packaging of respiring biological materials and which comprises

- (a) a microporous polymeric film comprising a network of interconnected pores such that gases can pass through the film, and
- (b) a polymeric coating on the microporous film, the coating comprising a polydimethyl siloxane;

wherein

- (1) the pores in the microporous film have an average pore size of less than 0.24 micron;
- (2) at least 70% of the pores in the microporous film have a pore size of less than 0.24 micron;
- (3) less than 20% of the pores in the microporous film have a pore size less than 0.014 micron;
- (4) at least 80% of the pores in the microporous film have a pore size less than 0.15 micron; and
- (5) the polymeric coating has a thickness such that the membrane
 - (i) has an oxygen permeability (OTR), at all temperatures between 20° and 25°C, of at least 775,000 ml/m².atm.24 hrs (50,000 cc/100 inch².atm.24 hrs; and
 - (ii) has a CO₂/O₂ permeability ratio(R) of at least 1.5;
 the OTR and R values being measured at a pressure of 0.035 kg/cm² (0.5 psi).

67. (New) A membrane according to claim 66 wherein at least 90% of the pores in the microporous film have a pore size less than 0.24 micron.

68. (New) A membrane according to claim 66 wherein at least 80% of the pores in the microporous film have a pore size less than 0.15 micron and at least 70% of the pores in the microporous film have a pore size less than 0.11 micron.

5 69. (New) A membrane according to claim 66 which has an OTR at all temperatures between 20°C and 25°C of 775,000 to 3,100,000 ml/m².atm.24 hrs and an R ratio of at least 2.5, the OTR and R values being measured at a pressure of 0.035 kg/cm² (0.5 psi).

10 70. (New) A membrane according to claim 66 which has an OTR of at least 2,325,000 ml/m².atm.24 hrs, measured at a pressure of 0.7 kg/cm² (10 psi).

71. New) A membrane according to claim 66 wherein the polymeric coating has been crosslinked.

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72. (New) A package which comprises

(a) a sealed container, and

(b) within the sealed container, a respiring biological material and a packaging atmosphere around the biological material;

20 the sealed container including one or more permeable control sections which provide at least the principal pathway for oxygen and carbon dioxide to enter or leave the packaging atmosphere, at least one said permeable control section being a gas-permeable membrane which comprises

25 (a) a microporous polymeric film comprising a network of interconnected pores such that gases can pass through the film, and

(b) a polymeric coating on the microporous film, the coating comprising a polydimethyl siloxane;

wherein

30 (1) the pores in the microporous film have an average pore size of less than 0.24 micron;

- (2) at least 70% of the pores in the microporous film have a pore size of less than 0.24 micron;
- (3) less than 20% of the pores in the microporous film have a pore size less than 0.014 micron;
- 5 (4) at least 80% of the pores in the microporous film have a pore size less than 0.15 micron; and
- (5) the polymeric coating has a thickness such that the membrane
 - (i) has an oxygen permeability (OTR), at all temperatures between 20° and 25°C, of at least 775,000 ml/m².atm.24 hrs (50,000 cc/100
 - 10 inch².atm.24 hrs; and
 - (ii) has a CO₂/O₂ permeability ratio(R) of at least 1.5; the OTR and R values being measured at a pressure of 0.035 kg/cm² (0.5 psi).
- 15 73. (New) A package according to claim 72 wherein at least 90% of the pores in the microporous film have a pore size less than 0.24 micron.
- 74. (New) A package according to claim 72 wherein at least 80% of the pores in the microporous film have a pore size less than 0.15 micron and at least 70% of the pores
- 20 in the microporous film have a pore size less than 0.11 micron.
- 75. (New) A package according to claim 72 which has an OTR at all temperatures between 20°C and 25°C of 775,000 to 3,100,000 ml/m².atm.24 hrs and an R ratio of at least 2.5, the OTR and R values being measured at a pressure of 0.035 kg/cm² (0.5
- 25 psi).
- 76. (New) A package according to claim 72 which has an OTR of at least 2,325,000 ml/m².atm.24 hrs, measured at a pressure of 0.7 kg/cm² (10 psi).
- 30 77. (New) A package according to claim 72 wherein the polymeric coating has been crosslinked.